Not Just a Random Scramble

Just what is it that beet armyworms want when it comes to choosing a place to raise offspring? After all, these insects live on a wide variety of plants, including cotton—a crop to which they can lay waste.

There is a lot of anecdotal evidence about what attracts the beet armyworm to particular plants and fields. But what is "known" on that basis may not be exactly so.

Now, data from ARS scientists at the Kika de la Garza Subtropical Agricultural Research Center in Weslaco, Texas, are shedding light on what the pest really prefers when it comes to picking a host plant for offspring.

ARS entomologists Shoil Greenberg, Allan Showler, and Thomas Sappington, with the Integrated Farming and Natural Resources Research Unit, have spent the past several years separating fact from folklore.

"It's well documented in the literature that pigweed, cotton, peppers, sunflowers, and cabbage, among many other species, are used as host plants by beet armyworms. But whether all are preferred equally was a big question because of implications for controlling this pest," explains Sappington. "Now we've found that beet armyworm moths display decided preferences when it comes to laying eggs."

SCOTT BAUER (K9882-1)

Under the direction of entomologist Tom Sappington (right), University of Texas-Pan American graduate student Peter Carreon attaches a beet armyworm moth to a flight mill.

Given free choice in laboratory experiments on individual leaves and in greenhouse studies using potted plants, females laid eggs four to five times more often on pigweed than on sunflower or cabbage, according to Sappington. Cotton and peppers were an intermediate choice, receiving only half as many eggs as pigweed.

In parallel studies, Greenberg and Sappington also found that beet armyworm larvae thrived better on pigweed and ate less of its leaves. The insects grew faster and larger than larvae from eggs laid on cotton or peppers, Sappington adds.

There were also differences in where on the plant eggs were laid, depending on the plant chosen. On cotton, most eggs were deposited on the undersides of leaves within the top part of the canopy and horizontally within the central part of the plant. On pigweed, eggs were also commonly laid within the central part of the canopy, but they were spread vertically throughout the plants. This information will be useful in devising efficient procedures for scouting for armyworms in crop fields and nearby weeds.

Greenberg is currently studying whether the type of plant the beet armyworm is hatched on makes a difference in which plant the females choose for the next generation. He raised three generations each on pigweed, cotton, and cabbage and then offered the moths a choice of host plants for egg laying. Sappington also attached fishing line to the female moths and fastened them to rotatable arms on flight mills to monitor differences in migratory flight behavior associated with host plant choices.

Preliminary data indicate that the plant these pests are raised on doesn't influence which plants the adult females seek out.

Showler, meanwhile, is studying what makes one type of plant more attractive than another. He looked at egg-laying choices when the insects were limited to their sense of smell—chemical cues—to identify a preferred host plant.

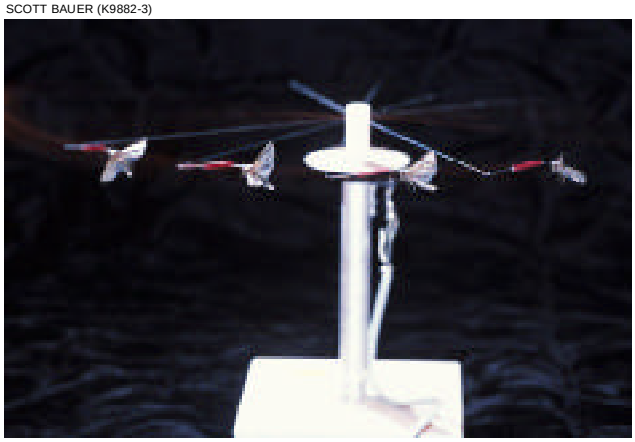
Working by smell alone, not only did the females lay 3.3 times more eggs on pigweed than on cotton plants, they also laid 4.5 times more egg clusters.

"When I saw these differences, I wanted to understand what was so attractive about pigweed," Showler says. "Most other host plant studies have focused on what deters beet armyworms from choosing a plant."

He also knew from other studies that pigweed provided a nutritional advantage, since the larvae developed faster and larger on it.

One major factor he found was that pigweed has much higher free amino acid levels than other host plants and a more diverse array of them. Unlike proteins, free amino acids don't have to be broken down before they can be used by the insect.

SCOTT BAUER (K9882-3)



A beet armyworm moth is attached to a flight mill, which allows it to fly in a circular pattern. Each revolution of the low-friction flight arm represents 1 meter of flight distance.

SCOTT BAUER (K9880-1)

To verify which plants beet armyworms prefer to eat and lay eggs on, technician Chuy Caballero (left) and entomologist Shoil Greenberg examine leaves of cotton, cabbage, and pigweed.

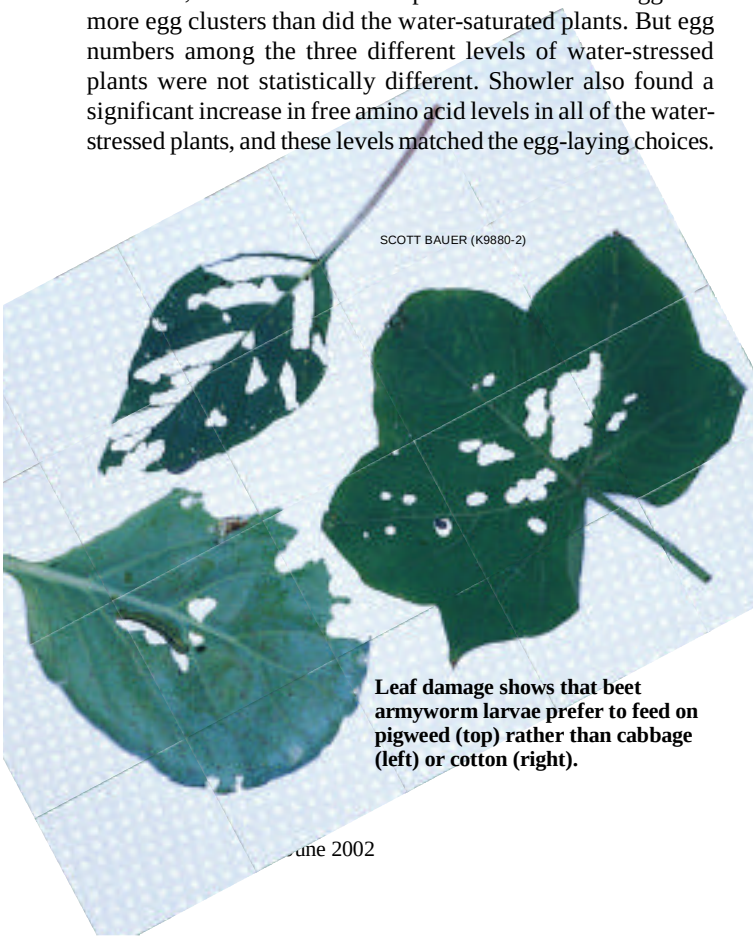
"In pigweed I've identified the presence of 9 of the 10 free amino acids that can provide a nutritional advantage to insects, and the 10th one may be there too," Showler says.

Sometimes it is not the type of plant but its condition that affects the pest's choice of where to lay eggs. One commonly held conviction, especially by cotton farmers, is that beet armyworms are more attracted to drought-stressed cotton plants.

To scientifically validate whether this preference actually exists, Showler offered egg-laying females the choice of water-saturated cotton plants or plants that received 1,500, 1,000 or 750 milliliters of water per week.

Indeed, all the water-stressed plants received more eggs and more egg clusters than did the water-saturated plants. But egg numbers among the three different levels of water-stressed plants were not statistically different. Showler also found a significant increase in free amino acid levels in all of the water-stressed plants, and these levels matched the egg-laying choices.

SCOTT BAUER (K9880-2)



Leaf damage shows that beet armyworm larvae prefer to feed on pigweed (top) rather than cabbage (left) or cotton (right).

But what didn't follow the expected course was survivability. Even though more eggs were laid on the water-stressed plants, the newly hatched larvae fared very poorly. So it does not follow that drought-stressed cotton is more likely to suffer damage from beet armyworms.

"There are anecdotal reports that if you are scouting a field for a beet armyworm outbreak, go first to the drought-stressed plants," Showler recounts. "That may be true for the presence of eggs, but it doesn't hold up for larvae because they don't survive well. So the presence of eggs alone is not necessarily a way to tell whether your field is going to become infested."

Collecting this type of basic biological data is critical because once the beet armyworm's behavior and development can be accurately predicted, it may be possible to exploit the information to devise better monitoring and control strategies.—By **J. Kim Kaplan,** ARS.

SCOTT BAUER (K9883-1)

Entomologist Allan Showler compares the amounts of free amino acids detected in extracts from leaves of pigweed and cotton to characterize their nutritional value to beet armyworms.

This research is part of Crop Protection and Quarantine, an ARS National Program (#304) described on the World Wide Web at http://www.nps.ars.usda.gov.

Shoil Greenberg, Thomas Sappington, and Allan Showler are in the USDA-ARS Integrated Farming and Natural Resources Research Unit, Kika de la Garza Subtropical Agricultural Research Center, 2413 E. Hwy. 83, Weslaco, TX 78596; phone (956) 969-4812, fax (956) 969-4800, e-mail tsappington@weslaco.ars.usda.gov, ashowler@weslaco.ars.usda.gov, sgreenberg@weslaco.ars.usda.gov. ◆